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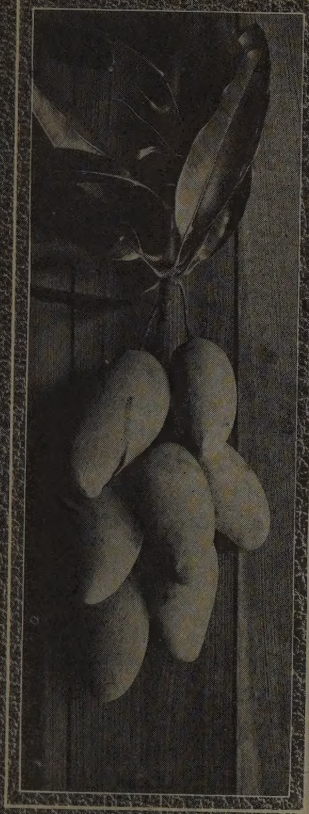
INSECTS INJURIOUS TO THE MANGO IN FLORIDA AND HOW TO COMBAT THEM



WITH THE DEVELOPMENT and increased propagation of the mango in Florida various insect enemies have made their appearance, and, when abundant in a grove, often cause considerable injury. Some of these insects are native and have adapted themselves to the mango, others may have been introduced into the State.

All parts of the mango—fruit, blossom, foliage, trunk, and branches—are attacked. The grower should watch his trees carefully for insect pests and apply control measures promptly. This bulletin contains brief descriptions of the principal pests attacking the mango in Florida and information on their life histories and the means, in each case, found most effective for combating them. The more serious foreign insect enemies of the mango are considered briefly, that the grower may recognize them and their work, should any of them enter the United States despite the rigid quarantines designed to keep them out.

Contribution from the Bureau of Entomology

L. O. HOWARD, Chief

Washington, D. C. Issued February, 1922

INSECTS INJURIOUS TO THE MANGO IN FLORIDA AND HOW TO COMBAT THEM.

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EVERY PART of the mango tree is at some time affected by one or more insect pests which cause concern and loss to the grower. While some of these insects may have been introduced, others probably have always been present on native vegetation and have adapted themselves to the mango.

INJURIOUS INSECTS OF THE MANGO IN FLORIDA.

THE BLOSSOM ANOMALA.

When the mango is in bloom it is sometimes visited in swarms by a beetle[1] which can cause serious damage. Fortunately, however, this beetle is not generally distributed at blossoming time. Groves in certain localities may be visited by large numbers of the beetles, yet other groves escape injury. Groves visited one year may escape the next, and others in turn may be attacked.

The adult beetle (fig. 1) has a black thorax with a yellowish border; the wing covers are yellowish mottled with two crossrows of ill-defined black spots. Variations in color often occur, some individuals being almost black. The beetle varies also in size, averaging from one-fourth to five-sixteenths inch in length.

This pest has been recorded from a number of localities along the lower east coast of Florida, it has been reported from a number of

[1] *Anomala undulata* Mels.

Middle Western and Eastern States, and is present in South America and Central America.

NATURE OF INJURY.

The beetles attack all portions of the blossom spike, and in many instances not only completely strip the spikes of the individual blossoms (fig. 2), but also cut or girdle the spike. Usually, however, the beetles confine their attack to the more tender floral parts, destroying the individual floral clusters about the spikes.

The beetles have been observed feeding upon avocado bloom, when blossoming has coincided with the appearance of the swarms. They have also been noted feeding extensively in bean fields in southern Florida, the plants becoming practically defoliated. In the Middle West this beetle has been recorded as infesting a variety of crops, often to their serious injury; in Ohio, as stripping the leaves from plum and pear trees; in Illinois, as defoliating cherry trees; and in Kansas as injurious to wheat and other grains, feeding on the heads when the grain is "in the dough."

FIG. 1.—The blossom anomala: Adult beetle. Much enlarged.

LIFE HISTORY.

During the day numerous freshly eaten floral spikes were found on mango trees in groves, but the presence of the destructive pest causing the damage could not be detected about the bloom or anywhere on the trees. Below the trees numerous small holes were present in the soil, and upon examination of the soil to a depth of from 1 to 2 inches a considerable number of small beetles were found in a quiescent stage, as if "playing possum." Upon short exposure to the light the beetles became active and immediately started to dig their way into the soil. During the evening great numbers of the same beetles were found busily at work among the trees in a grove, feeding on and flying about the blossom spikes.

After a period of several weeks the beetles usually disappear. Up to the present time the writer has been unable to locate the larva of this species and nothing is known of its habits. Judging, however, from similar species, the larva form, except for its smaller size, is similar to white grubs, or May-beetle larvæ, not only in general appearance but more or less in habits also. The larvæ probably will be found feeding on the roots of some plant or on decomposing veg-

etable matter in the soil, either on the pine lands or in the stretches of everglades. In the Middle West, where this species also occurs, nothing has been recorded as to its larval habits.

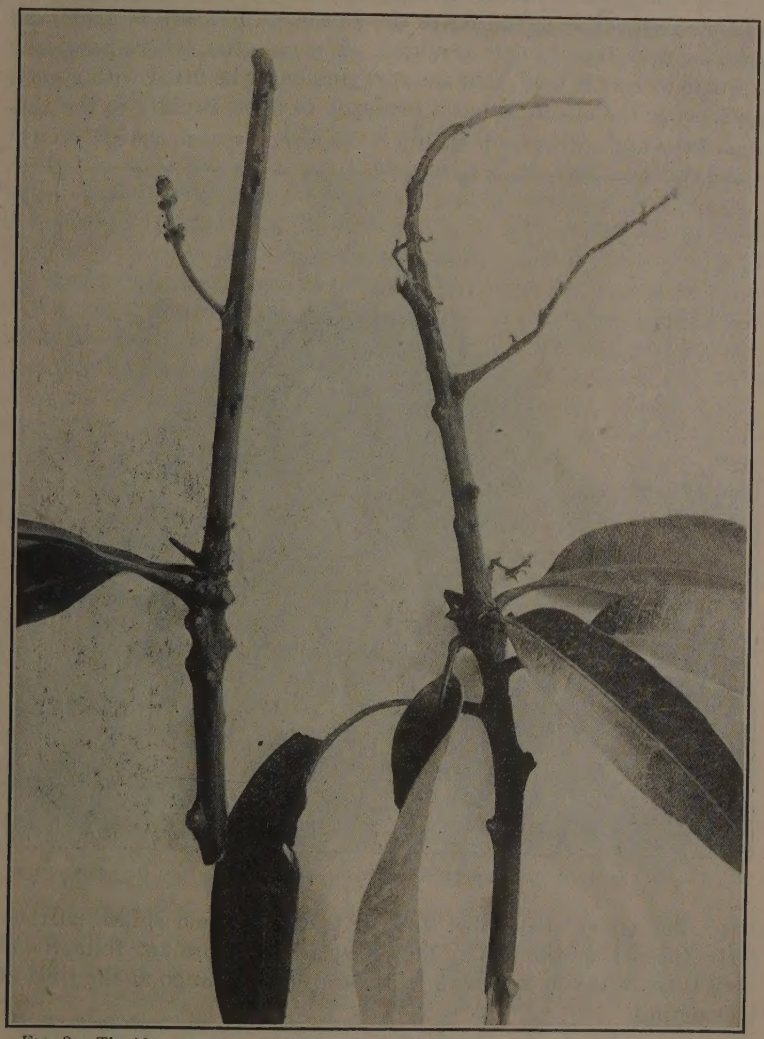

FIG. 2.—The blossom anomala: Injury by the adult beetles to mango blossom spikes.

CONTROL.

The best means of control is spraying the bloom spikes with poison. When the mango is sprayed in the bloom with Bordeaux mixture for the Colletotrichum blight, which attacks both bloom and

fruit, arsenate of lead at the rate of 1½ pounds of the powder to 50 gallons of spray should be added, thus making a combination treatment for blight and beetle. The Bordeaux mixture is generally used at a strength of 3–4–50. After the Bordeaux mixture is made and is in the tank the arsenate is added. It is essential, where powdered arsenate of lead is used, that the spraying outfit be fitted with a good agitator, as the arsenical has a tendency to settle rapidly to the bottom of the tank, whereas it should be kept in suspension while spray-

FIG. 3.—The blossom anomala: Spraying mango trees in bloom against the adult beetles.

ing. The spray should be directed to the blossom spikes particularly (fig. 3), as the beetles do not attack the dormant foliage and very little if any new growth is present on the mango at the time of blossoming.

THE RED SPIDER.

The red spider[2] which seriously attacks the avocado in Florida also attacks the mango during the dry winter months. It is similar in shape and appearance to other red spiders which attack various

[2] *Tetranychus yotherst* McG.

other fruits. The greatest damage usually is inflicted between the latter part of November and the 1st of March. The abundance of the pest during this period depends chiefly on the existing climatic conditions. Unlike most other red spiders, the red spider of the mango and avocado confines its attacks to the upper surface of the foliage.

NATURE OF INJURY.

The foliage attacked turns brown and often drops prematurely, and at times there may be a heavy denudation as a result of the depredations of these mites. They multiply so rapidly that the damage caused by them becomes quickly noticeable. The first indication of red spiders on the foliage is the pale spots scattered about over the leaf surface, showing the feeding places. As the feeding becomes more general most of the functional green matter in the leaf is destroyed, and in time such a leaf turns brown as if scorched and is of little use to the tree. Where the red spiders become numerous in a mango grove, considerable damage results from their attack on the hardened winter foliage through absorption of the functional leaf substance. It is the winter foliage which sustains the bloom in the spring and aids in the setting of the fruit.

DESCRIPTION AND SEASONAL HISTORY.

The egg.—The egg of the red spider is globose, smoky amber in color, about $\frac{1}{150}$ inch in length, and bears a stalk which varies in development from a length equaling the height of the egg to a mere rudimentary papilla; guy fibrils are occasionally seen connecting the egg with the leaf. The eggs are laid on the upper surface of the leaf, usually along the midrib and lateral veins. The incubation period varies according to temperature and general climatic conditions. During midwinter, with mean daily temperatures between 60° and 70° F., incubation requires from 7 to 11 days. During April and May incubation requires an average of only 4 to 5 days, with mean temperatures between 70° and 80° F.

The larva.—The newly hatched larva is round and a very light yellow or almost colorless. It bears six legs and in size does not exceed that of the egg from which it emerged. The average period required for development of the larva is about $2\frac{1}{2}$ days.

The nymphal stages.—Before reaching the adult stage the mite goes through two molts. In the nymph stage which follows the larva stage, the mite attains an extra pair of legs, making four pairs. The first nymphal stage is about one one-hundredth inch in length and the second nymphal stage about one seventy-fifth inch. For the most part the habits of the first and second nymphal stages are similar

to those of the larva. The average length of the nymphal stages is about 3 days.

The adult mite.—The adult is eight-legged and the color is rusty-red, because of the internal structures occurring on each side of the body. The eyes are crimson. The body and legs are covered with minute hairs. The male is about one one-hundredth inch in length and the female about one-eightieth inch. In this stage the mites are very active, mating and extensively feeding on the foliage. The number of generations of the red spider varies with the seasonal climatic conditions. In years of little rain during the spring and early fall the red spiders become in evidence more quickly than when rains occur in early spring and early fall. Rain is the factor which influences their reduction more than any other. Intermittent rain frequently recurring during the red-spider season also interferes greatly with the regularity of the generations. Activity of the red spider usually commences during the latter part of August and ceases the first part of April, giving an active season of about 240 days. The duration of the life cycle based on averages is 14.2 days. This would give 17 generations for Florida, if no interruptions due to climatic conditions occurred, or if no other factors interfered with the normal activities of the mites in the field. The length of the generations, however, varies greatly with the climatic conditions. During dry, hot weather the females deposit eggs in great numbers and the growth and molting of the spiders take place rapidly. During colder weather apparently days are passed without any eggs being laid and growth of the immature individuals is much retarded. Although the life cycle is longer during January and February, the climatic conditions do not interfere and the mites reproduce freely. During May, June, and July, and sometimes in August, depending on the weather, the mites are very scarce, but are present on the trees, though barely maintaining their existence.

CONTROL.

When the mites are present on the trees in considerable numbers and the foliage is still green the grower should start immediately to apply control measures. He should not wait until the attacked foliage becomes noticeably brown and begins to drop. By applying either dust sulphur with a dusting machine, or lime-sulphur solution at the rate of 1 gallon of the concentrate to 60 gallons of water, the grower will secure satisfactory results. With lime-sulphur solution a strength of 1 gallon of the concentrate to 75 gallons of water is advisable during winters if the temperature is above the normal, and if the trees do not attain a thoroughly dormant condition.

THE RED-BANDED THRIPS.

The red-banded thrips,[3] an important enemy of the cacao in the West Indies islands of Grenada, St. Vincent, St. Lucia, Dominica, Guadeloupe, Trinidad, Tobago, and the Virgin Islands, in the island of Mauritius, and in Uganda, East Africa, has found its way into the United States, is present in Florida, and has been found infesting mango trees on both the lower east and west coasts of that State.

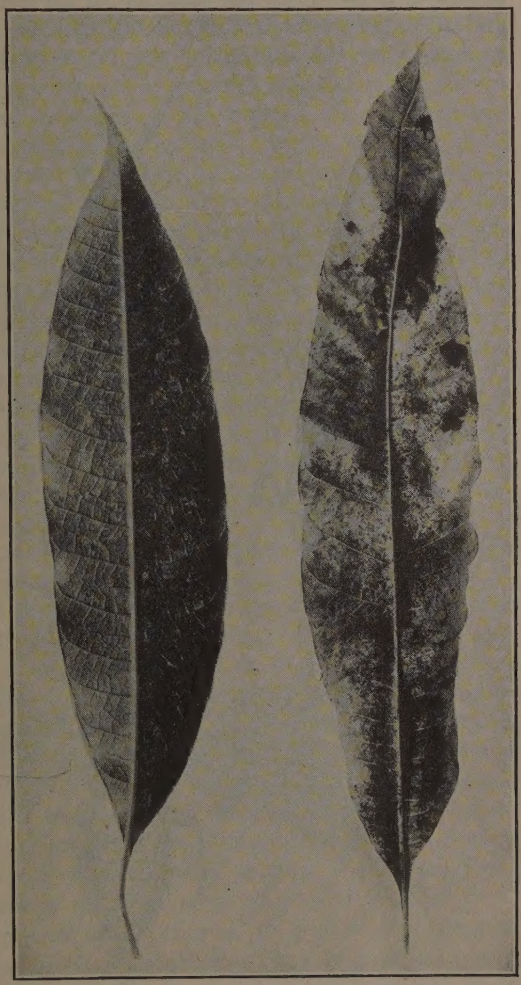

FIG. 4.—The red-banded thrips: *a*, Uninjured leaf; *b*, leaf badly injured by the feeding of the thrips. (Russell.)

CHARACTER OF INJURY.

Injury by the red-banded thrips is very similar to that of the greenhouse thrips and of a number of other thrips. The adults and the young may be found feeding together on the lower surface of the foliage, causing injury by first piercing the surface of the leaf with the sharp mouth parts, then rasping or scraping out the leaf tissue within and leaving a minute spot where the chlorophyll or green contents of the leaf has been removed. This spot eventually becomes brown. These spots become very abundant and after a while run together, forming large brown patches near the

[3] *Heliothrips rubrocinctus* Giard.

midrib and lateral veins, the leaves later turning brown and shriveling. In severe cases the entire lower surface of the leaf is infested, and the larvæ seek the upper surface of the foliage, where they commence to feed. Thus the function of the leaf is entirely destroyed and often the leaves dry up and fall (fig. 4). In feeding, this thrips excretes over the surface of the infested leaves small spots of a

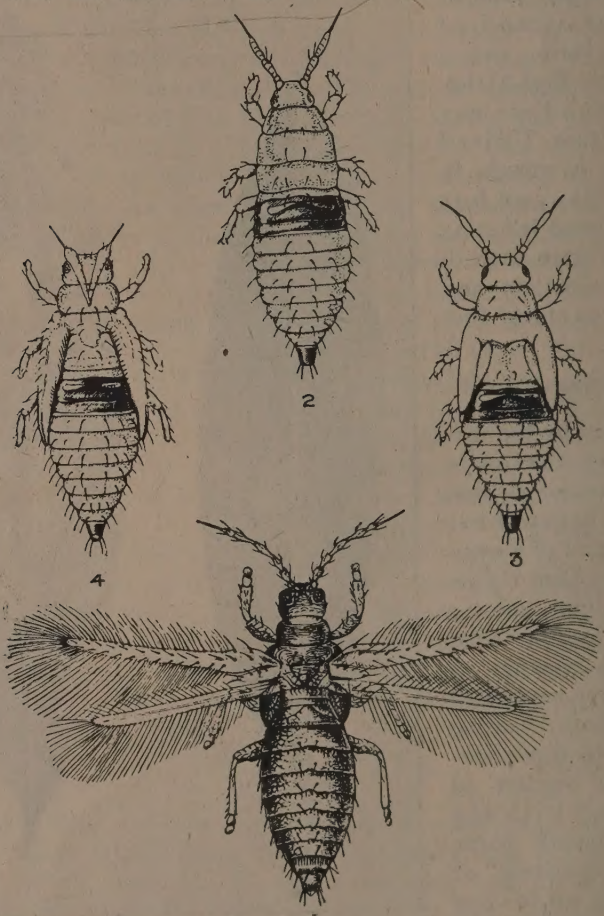

FIG. 5.—The red-banded thrips: *1*, Adult female; *2*, full-grown larva; *3*, prepupa; *4*, pupa. (Russell.)

reddish fluid, which harden and turn black. The species has not been observed to attack the fruit.

DESCRIPTION AND SEASONAL HISTORY.

The egg.—The egg is oval in shape, transparent, and averages approximately one-ninetieth inch in length. The eggs are inserted

into the tissues of the lower surface of the mango leaf. The writer has found that the incubation period requires an average of from 10 to 15 days.

The larva.—The larva (fig. 5, *2*), or young, is about one ninety-sixth inch in length upon emergence. It is spindle-shaped, tapering gradually toward the tail end. The head is rather square, rounded in front, with red eyes. The general color is yellow, except several segments of the body which are crossed by a bright red band and the anal segment, which is red. From hatching until growth is completed, about 9 to 18 days as a maximum are required, depending upon temperature and humidity. The larvæ feed on the leaves in company with the adults and generally prefer the underside, but also may be found on the upper side of the foliage. They feed in colonies in folds of the leaf, or along the midrib. As they feed the leaf becomes full of minute brown spots where the chlorophyll has been extracted, and in severe cases these run together and the entire leaf becomes brown and shriveled. At all times the larva holds the tip of the abdomen elevated, and on it a drop of reddish liquid, held more or less in place by the stout anal hairs, collects. The drop increases in size and falls to the leaf, the surface of which finally becomes covered with the excrement, an occurrence also common in the case of other thrips.

The prepupa and pupa.—Like all thrips, the species passes through two intermediate stages called the prepupa and the pupa (fig. 5, *3*, *4*) before the adult thrips is reached. These two stages do not differ materially in structure or appearance. The prepupa measures on an average one twenty-fifth inch in length, and the pupa approximately the same. The prepupæ remain clustered so closely that they almost touch and are nearly motionless. If disturbed, however, they move rapidly about on the leaf. The prepupæ change to pupæ in the colony of prepupæ and larvæ. When the prepupa is ready to molt, the skin is ruptured over the head, gradually worked off at the posterior end by contractions of the body, and left behind on the leaf. The average period of the prepupa stage was from two to five days, depending upon the temperature and humidity.

The pupæ, though possessing the power of motion, are sluggish and will not move around unless disturbed. They carry the antennæ folded back over the head. As the pupæ approach maturity their bodies begin to turn darker, and just before emergence of the adults become almost black. The adults emerge from the pupæ in the same manner that the younger stages molt; they then move a little way off and remain more or less motionless until the chitin hardens. Within a day the full colors have developed and the adults begin

feeding. The pupa stage was found to require on an average from three to seven days for development.

The adult.—The adult (fig. 5, *1*) can be separated from others associated with it by the body characters, black with dark wings, by the reddish band which is evident in the first three segments of the abdomen, and by the red color of the anal segment. The adult female is about one twenty-fourth of an inch long and quite stout. The adults feed gregariously with the pupæ and larvæ, all in close proximity to one another, and in many cases rest alongside the midrib or lateral veins of the leaf. The adults select the tender foliage to feed upon, and there the female deposits eggs in the leaf. In Florida the life cycle is influenced greatly by the temperature conditions. During the late summer and fall the life cycle requires approximately 25 days as a minimum, and during the months of January and February 35 days are required. In Florida this insect may pass through from 10 to 12 generations during the year. Rain is one of the controlling factors in the abundance of the thrips at any time.

CONTROL.

Spraying with 40 per cent nicotine sulphate at the rate of 1 part to 900 parts of water has been found the most efficient means of controlling the red-banded thrips. The addition of 2 or 3 pounds of fish-oil soap to the diluted mixture will cause the spray to spread more evenly over the smooth mango foliage and not drop off in small globules. Where the red spider is present on the foliage at the same time as the thrips the nicotine sulphate may be added to lime-sulphur spray, the nicotine being used at the strength indicated above. In this case no soap should be added. The spray should be directed particularly against the lower surface of the leaves, as the thrips will usually be working there. The spray should be applied before the foliage commences to turn brown, when indication of the presence of the thrips is first detected on the green foliage.

THE MANGO SHIELD SCALE.

A number of scale insects attack the mango in Florida, and the one noted to be most injurious up to the present time is the mango shield scale[4] (fig. 6). This scale is quite widely distributed and is found wherever the mango is growing. It has been taken at Fort Myers, Punta Gorda, Palm Beach, Miami, Miami Beach, Biscayne Key, Larkins, and Homestead. The species has been reported from British Guiana and from the following islands of the West Indies: Grenada, Barbados, Dominica, Antigua, Trinidad, and Jamaica.

[4] *Coccus acuminatus* Sign.

CHARACTER OF INJURY.

The mango shield scale infests the lower surface of the mango leaves, where it is to be found usually clustered in rows along both sides of the midrib and the lateral veins. Like all other scales, this species does damage principally through the extraction of the sap contents of the plant. An indirect injury also results, in that, like many other scales, this species produces an abundance of honeydew. This honeydew collects on the bodies of the scales, and when the drop is sufficiently large it falls either to the upper surface of lower leaves or to fruit below. The sooty-mold fungus develops in this honeydew, the accumulation of which gives in time a decidedly blackened appearance to the foliage and fruit (fig. 7). The writer has observed several groves where the sooty mold was so abundant that even the branches and trunks of the trees were blackened by it.

FIG. 6.—The mango shield scale: Showing scales along the midrib of the lower surface of a mango leaf.

SEASONAL HISTORY AND DESCRIPTION.

The adult scale.—The adult scale is yellowish green, bluntly pointed in front, and broadly rounded posteriorly. It is very thin and flat and irregularly marked with black. There seems to be no dormant period in the life of this scale, as young are to be

FIG. 7.—The mango shield scale: Showing sooty-mold fungus accumulation on upper surface of mango leaves.

found at almost any time of the year. The activities of the scales, however, are much retarded during the winter when the foliage of the mango is dormant. During winter more adult scales are present in proportion to the young. This no doubt is due to the lack of young foliage and the lower temperature. The adults reproduce almost continuously on the mango in Florida, and the generations overlap considerably, so that at any time the scales may be found in all stages of development.

The young, or "crawlers."—During the latter part of February or the first part of March, as the new growth commences on the mango, the "crawlers" appear in great numbers. These are born beneath the adult scales on the older leaves, and as their natural instinct is to seek the newer growth of foliage, great numbers of these small crawlers may be seen traveling toward the newer foliage along the twigs. In due time in the spring, the mango, like the avocado, sheds its older leaves and with them many scales, but a sufficient number has gained foothold on the newer growth to perpetuate the species on the tree and to continue the infestation. As with other scales of a like nature, the young are tiny, oval in shape, provided with antennæ, six legs, and threadlike mouth parts. After wandering about for a short while, the young scale settles down, thrusts its threadlike mouth parts into the tissues of the leaf, and begins the extraction of the sap, upon which it feeds. With the first molt the crawlers lose their antennæ and legs. As the scale grows, the cast skins are thrust aside for a new and larger covering. Crawlers which were placed on leaves February 2, 1918, became adult scales May 20, 1918, showing that at this time of year approximately $3\frac{1}{2}$ months are required to go through a generation. From the writer's observations approximately three generations are produced on the mango in southern Florida. During the latter part of June and early July great numbers of the crawlers are in evidence. The generations overlap greatly, however, and there is no distinct demarkation showing when one generation ends and another begins.

In Florida, the writer has taken this species on the rose apple, custard apple, sapodilla, mango, and Allamanda. In the West Indies it has been recorded on mango, breadfruit, Jasminum, Ixora, sapodilla, Allamanda, star plum, star apple, nutmeg, and custard apple.

CONTROL.

The best time to control this scale on the mango is when the trees are dormant, as from the middle of December until the first of February. Oil emulsions have been found satisfactory. There are a number of oil emulsions on the market, some of which when applied to the waters used in spraying in southern Florida work very satis-

factorily. Generally these waters come from deep wells in the limestone formation and are termed "hard," but some, which come from surface wells, are as a rule brackish. Certain oil emulsions when combined with these "hard" waters may prove at times unsatisfactory, in that the calcium and magnesium salts present in the water tend to break up the emulsion, causing the oil to be set free during spraying. This free oil is detrimental to mango foliage and causes severe burning. Where a grower has knowledge of such separation, spraying operations should be discontinued and the trouble remedied.

Where separation of oil occurs in using an oil emulsion with the water a grower has available, the water should first be softened by means of caustic potash fish-oil soap. This soap has been found to be satisfactory when 3 or 4 pounds are used to a 125-gallon tank of ordinary hard water. After the water has been softened, the oil emulsion should be added to the tank. There are a number of oil emulsions which contain the proper stabilizers, so that when the emulsion is combined with hard water no separation occurs, thus doing away with the additional expense and labor of softening. As a preliminary precaution it is advisable to test the spray before starting operations in the field. Barring a few difficulties which a grower may experience in the use of oil emulsions with hard water, the emulsions will prove to be most efficient sprays for the control of scales attacking the mango in Florida.

Oil emulsions during the dormant season on the mango at a strength of 1 part to 70 parts of water have proved very satisfactory. Two applications during the winter, with an interval of three weeks between, are recommended. These applications should be so timed, however, as not to interfere with spraying for the red spider or thrips. It has been found that the use of 40 per cent nicotine sulphate solution, at the rate of 1 part to 900 parts of spray, with the diluted oil-emulsion sprays, gives satisfactory results against the scale insects and thrips and temporary relief from the red spider.

THE TESSELLATED SCALE.

Another soft-bodied scale, often found infesting the mango in Florida, is the tessellated scale[5] (fig. 8). It is oval in shape but broadly rounded posteriorly. It is of a dark-brown color, with a decidedly mosaic appearance on the upper surface. It is not so generally distributed in Florida as the mango shield scale, being found only in a few localities on the east and west coasts of Florida. The writer has taken it at Little River, Oneco, Palm Beach, and Miami.

[5] *Eucalymnatus tessellatus* Sign.

CHARACTER OF INJURY.

Injury resulting from the feeding of this scale is of the same nature as that from the mango shield scale. The seasonal history of this species does not differ materially from that of the mango shield scale, approximately three generations in the year being produced. The plants which this scale infests have been found to be the coconut palm, fishtail palm, and mango.

CONTROL.

The oil-emulsion sprays, as recommended against the mango shield scale, are advised in the control of this pest.

THE FLORIDA RED SCALE.

A scale found to infest the mango at times is the Florida red scale[6] (fig. 9). Occasionally it may be found infesting both the leaves and fruit of the mango. The scale is dark reddish-brown in color, with a conspicuous light-brown center, almost circular in outline, and is about one-twelfth of an inch in diameter when full grown. Besides the mango, this scale infests citrus, the royal coconut, and many other palms, camphor, magnolia, oleander, roses, myrtle, and many other plants.

CHARACTER OF INJURY.

This species does not produce honeydew, and hence the sooty-mold fungus is not found where it is present on the trees. Like the other scales, its principal injury is caused through the extraction of the sap from the foliage and fruit.

FIG. 8.—The tessellated scale: Showing scales on the lower surface of a mango leaf.

[6] *Chrysomphalus aonidum* L.

The eggs produced by this species are yellow. From the eggs come crawlers, bright yellow in color and oval in outline. They begin to form their scales when less than a day old. By the second day they cease to crawl and by the third day the scale has become nearly circular. The first molt occurs at the age of about 3 weeks. The male of this species is a very delicate two-winged insect which appears at a certain period of development of the female scale; its life is very brief and after mating it soon dies. Egg laying begins when the females are about 10 weeks old and continues for two weeks.

FIG. 9.—The Florida red scale: Adult scales on mango fruit.

CONTROL.

The same oil emulsions which are used against the soft scale insects of the mango may be used against this scale also. On account of the thick and heavy scale, however, which fits the leaf or fruit very closely, the mature females and the eggs under the scales are not easily killed. To control effectively a heavy infestation of this scale, therefore, two or three sprayings may be necessary. The second should be applied from 3 to 4 weeks after the first. This will give the females that were not killed by the first spraying time to mature and die and their last eggs to hatch, but will not allow sufficient time for a new generation to mature.

THE MANGO SCALE.

A scale insect which is to be found on the limbs and trunk of the trees is the mango scale[7] (fig. 10). It masses in cracks or under loose bark, and resembles minute seeds or eggs. When numerous it also appears somewhat like the chaff scale on the branches and trunk of the tree. It is not very destructive. The female scale is from one-fiftieth to one twenty-fifth inch in length. It is narrow and flattened at the tip. The scale is convex and has a loosely adhering, saclike, waxy white covering. It does not infest plants other than the mango,

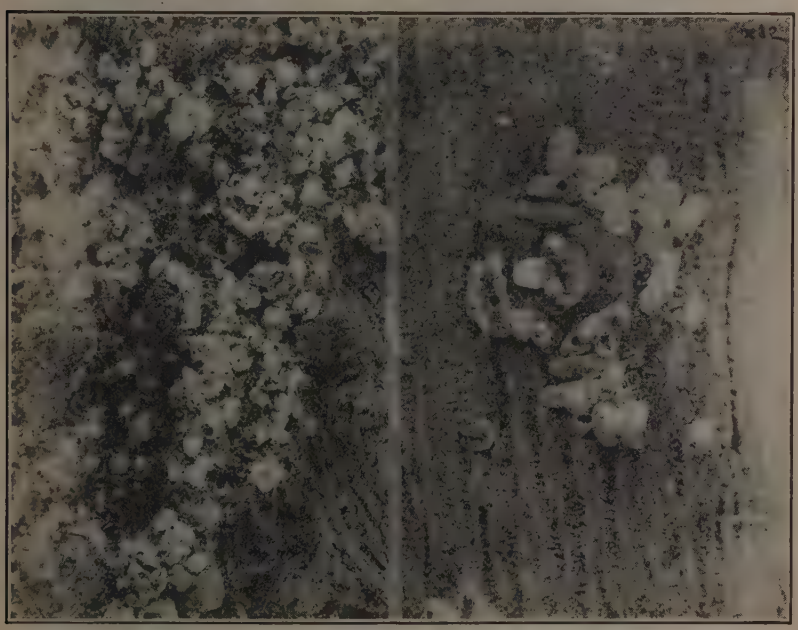

FIG. 10.—The mango scale: Adult scales on mango bark. (Photograph by Sasscer.)

and has been found at Homestead, Larkin, Palm Beach, Little River, and Miami. It is a pest of the mango in India, and was apparently introduced into Florida from that country.

CONTROL.

The oil emulsions, as used against the soft scales during the winter, have been found most satisfactory for this species, the spray being directed toward the branches and trunk of the tree with sufficient pressure for penetration, preferably 250 pounds.

[7] *Leucaspis indica* Marlatt.

THE FLORIDA WAX SCALE.

The Florida wax scale[8] (fig. 11), when not obscured by sooty mold or other foreign matter, is pure white, often with a pinkish shade imparted to it by the red color of the insect beneath. When seen against the deep green of the mango leaf or stem, it is a beautiful object. The full-grown female is an eighth of an inch or less in length, oval in general outline, but presenting an angular appearance, due to the dome-shaped masses of wax on the back. Of these there is one large, rounded, central dome, surrounded by six or eight

FIG. 11.—The Florida wax scale: Adult and young scales on mango leaf.

lesser ones, placed in a circle about the margin of the scale and separated from the central dome by a depression.

The eggs are dark red and many are clustered beneath an adult female. The pale-brown crawlers show a preference for the leaves, where they collect, especially along the midrib on the undersurface. The young larvæ are star-shaped and even more beautiful than the adults. Three or four months are required for growth, and there are three principal broods of crawlers, which appear during April and May, July and August, and October and November.

[8] *Ceroplastes floridensis* Comst.

Besides the mango, this scale infests citrus and gallberry, guava, cherry laurel, sea grape, Ficus, loquat, and many other plants.

CONTROL.

Should it become necessary to spray for this scale, the oil emulsions will be found satisfactory. As the scale possesses a hard covering, three sprayings will perhaps be necessary to control it completely.

FOREIGN INSECT ENEMIES OF THE MANGO WHICH SHOULD BE KEPT OUT OF THE UNITED STATES.

In its native lands the mango has a number of very destructive insect enemies, which, were they to follow it and gain entrance to the United States, would probably prove highly destructive. The United States Department of Agriculture, fully aware of the possibilities of the introduction of dangerous foreign mango pests, has established rigid quarantines, and with the cooperation of the States where mangoes are grown is doing everything possible to protect the mango industry.

The most serious pests of the mango in foreign lands are the fruit flies, of which four species are conspicuous, namely, the Queensland fruit fly, the mango fruit fly, the Mexican fruit fly, and the West Indian fruit fly. The adult flies lay their eggs on or in the fruits, into which the young, or larvæ, burrow, rendering the fruits unfit for food.

The Queensland fruit fly[9] is found in India, Ceylon, Java, Amboina, and Australia. The adult measures about one-fourth inch in length, with a wing expanse of about one-half inch. The wings are transparent, and the body is constricted at the base and broadly rounded at the tip. The thorax possesses a broad, creamy, often pale, dorsal band. Besides the mango, this species infests the banana, peach, nectarine, orange, apple, cheesewood, loquat, and a number of other fruits.

The mango fruit fly[10] is found in India, Java, Ceylon, Amboina, and the Philippine Islands. It is particularly injurious to overripe fruit and is the commonest species in India and Ceylon. Besides the mango, it infests a number of citrus fruits. The adult measures about one-fifth inch in length. The color is rusty red, with the upper surface of the thorax varying from black to rusty red, and sometimes the abdomen is marked with almost black bands.

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[9] *Bactrocera tryoni* Froggatt. [10] *Dacus ferrugineus* Fabricius.

Dacus ferrugineus, F.

The Mexican fruit fly,[11] known also as the Mexican orange maggot and Morelos fruit worm, is found in Mexico, where it is considered a serious pest of the mango, orange, sweet lime, guava, and a number of other plants. The adult measures nearly one-third of an inch in length and is of a dull ocherous yellow color, with the wings transparent, mottled, and striped with brownish-yellow bands. The eggs of this species are deposited under the skin of ripening fruit.

The West Indian fruit fly,[12] might be introduced into Florida and the other Gulf States, as it is at present in Mexico, Central America, South America, and the West Indies, where it infests the guava, coffee, pear, peach, mango, Para plum, Japanese plum, Japanese persimmon, and a number of other fruits. In these countries it is considered a very serious pest. The adult fly is about one-half inch in length, with a wing expanse slightly over 1 inch. The color of the body is rust yellow or brownish yellow. The wings are clear, tinted in part with a characteristic pattern of yellow brown.

The mango hopper[13] is a mango pest which in certain parts of India is reported to reduce the mango crop to one-third its normal value. The adults are small, dark, wedge-shaped insects which jump when disturbed. They appear at the time the mango is in flower, the time at which the principal injury is done. The eggs are laid and hatch in the flower panicles, and the young as well as the adults blight the bloom by sucking the juices that should assist in the formation of the fruit.

The mango seed weevil[14] is a serious enemy of the mango, especially in Hawaii, where it is reported to have infested from 60 to 90 per cent of the crop. There is danger of its introduction inside the seed. It is also present in the East Indies, the Philippines, the Straits Settlements, Madagascar, and South Africa. The adult weevil is from one-fourth to one-third inch in length. When it is nearly developed it is pale pinkish in color, later changing to a dark brown with yellow markings. The egg is deposited in the fleshy part of the fruit. When hatched the larva enters the seed, undergoes its entire development there, and emerges as an adult.

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[11] *Anastrepha ludens* Loew.
[12] *Anastrepha fraterculus* Weid.
[13] *Idiocerus atkinsonii* Leth.
[14] *Sternochetus mangiferae* Fab.

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